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Research Article

Estimation of Proximate, Micronutrients and Glycaemic Index of Talas Safira (*Colocasia esculenta var. Antiquorum* Schott) Growing in Bantaeng-Indonesia

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ABSTRACT
Bantaeng people cultivate Talas safira (*Colocasia esculenta* var. Antiquorum Schott) and commonly eat it as a staple food in their daily as carbohydrate sources. The effect of carbohydrate to glucose blood level can be refer to as glycaemic index (GI) and glycaemic load (GL). A diet with a high GI and GL are associated with an elevated risk of type 2 diabetes and obesity. We investigated proximate, micronutrient, heavy metal, GL and GI of Talas safira which cultivated in Bantaeng. The result revealed marked that Talas safira contain carbohydrate; essential micronutrients and rich of energy (380.55 kJ/100 g). High content carbohydrate of Talas safira refer to high level of GL (high) and GL (high). This results indicated that Talas safira needs attention to people with metabolic glucose disorder.

Keywords: *Colocasia esculenta*, proximate, glycaemic index, glycaemic load

INTRODUCTION

Colocasia esculenta (L.) Schott (Talas safira), an annual herbaceous plant widely as a staple food in human diet. The corms rich of nutritional components: carbohydrate (a starch-rich and more calories than potatoes), protein, minerals, lipids, unsaturated fatty acids and anthocyanin[1,2]. Food rich carbohydrate contribute to high glucose level in blood. The glycaemic index (GI) indicates the extent to which a carbohydrate containing food affects postprandial blood glucose levels compared with a reference product refer to obesity, type 2 diabetes mellitus (DM2), coronary heart disease, insulin resistance and other metabolism disorder disease[3].

Talas safira cultivation is firmly established in Bantaeng because of its fertility reasons, easy to growth without fertilizer. Food consumption is one of the most important pathways for human exposure to heavy metals[4]. As a place to store food reserves, tubers have high ability to accumulate metals from the environment through the roots and foliar surfaces. Several metal like calcium (Ca), sodium (Na), zinc (Zn) are essential nutrient for metabolism cause part of the enzyme. Other metal like lead (Pb), cadmium (Cd) and arsenic (As) constitute non-essential, becomes toxic at low concentrations as environmental food contaminants[5].

Therefore, the aims of this study were (i) to estimate the proximate, (ii) to determine the levels of 3 essential elements (Ca, Na and Zn) and 3 heavy toxic metals (Pb, Cd and As), (iii) to evaluate the GI and GL of Talas safira on mice Balb/C.

MATERIALS AND METHODS

Material

The chemicals and standards for the study were procured from Sigma Aldrich (St Louis, USA), Merck specialities (USA) and Nacalai (Japan).

Sampling

Talas safira tuber was collected from Bantaeng Regency, South Sulawesi. Tuber was harvested during rainy season, January-February 2016.

Sample treatment

Fresh Talas safira tubers were processed to separate the pulp and skin. The pulp (edible part) was only considered for analysis. Sample was thoroughly washed under tap water for 30 s to eliminate dirt, soil and sand particles and washed again with aquadest and millipore water for atomic absorption spectrophotometer (AAS).

Proximate composition

Moisture was calculated with gravimetric method drying in an oven at 105°C during 24 h upon constant weight achieved. The crude protein contents were determined using Lowry method. The crude fat contents were determined with continuous extraction in a Soxhlet apparatus for 6 h using hexane. The total ash contents were determined by incinerating in a furnace at 550°C[6]. The method described by Dubois et al. (1956) was used for the

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Glycaemic Index (GI)

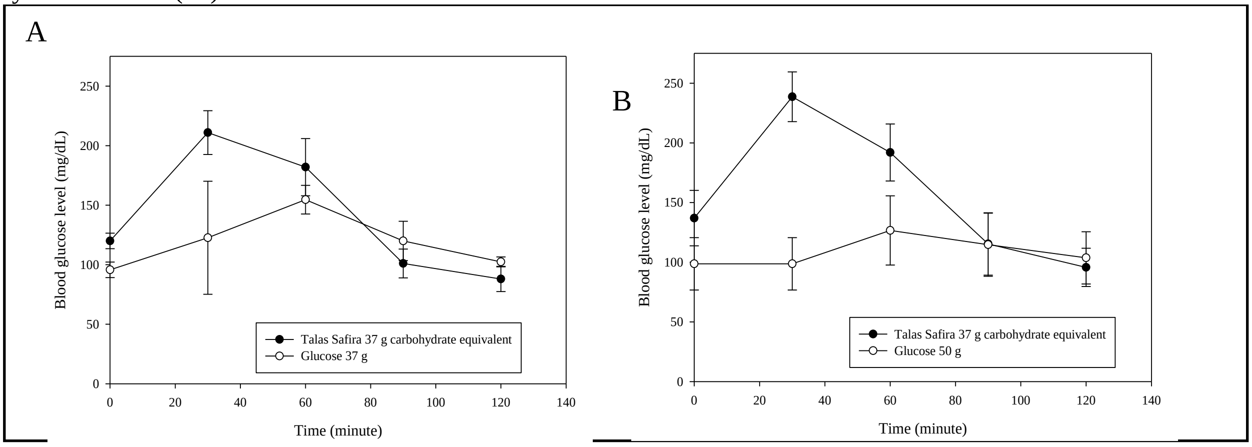

Figure 1: Level of blood glucose; [A] after consume Talas Safira 37 g carbohydrate (●) equivalent compared with glucose (○) [B] after consume Talas Safira 50 g carbohydrate (●) equivalent compared with glucose (○).

Table 1: Proximate analysis of Talas safira from Bantaeng.

Nutrients	Value
Proximate (g/100 g)	
Moisture	69.36
Total ash	1.70
Total carbohydrate	27.11
Crude fat	0.20
Protein	0.90
Total phenolic compound, (g/ 100 g)	275.277[a]
kJ/ 100 g	380.55

[a] Relative value against gallic acid equivalent (mg/100g).

Table 2a: Micronutrients and heavy metals contain.

Parameter	Value
Micronutrients (mg/100 g)	
Calcium	39.10
Sodium	9.21
Zinc	0.15
Oxalate (mg/100 g)	0.11
Heavy metal	
Cd	0,13
Pb	0.05
As	nd

Note: nd= not detected.

total sugar contents analysis[7]. The reducing sugar contents were determined according to the method of Miller (1959) using 3,5-dinitrosalicylic acids[8]. The total phenolic compound contents were determined as described in Hanson et al. (2004) from the methanol extract using Folin-Ciocalteu reagent[9]. The carbohydrate contents were determined by deference that is by deducting the mean values of other parameters that were determined from 100. Therefore % carbohydrate = 100 - (% moisture + % crude protein + % crude fat + crude fibre + % ash).

Determination of oxalate

Oxalate content was determined by titration method described by Day and Underwood (1986)[10]. In conical flask, one gram of the sample was added 3 mol equi/L H_2SO_4 and homogenised with a magnetic stirrer for 30 min and filtered using Whatman. Filtrate was titrated while hot against 0.1 mol equi/L $KMnO_4$ solution. The end point of titration is until a faint colour persisted for at least 30s.

Micronutrients and heavy metal

The micronutrients (calcium, sodium and zinc) and heavy metal (cadmium, lead and arsenic) were analysed through AAS (Shimandzu Scientific Instrument, USA). Briefly, a known of the sample was converted into ash in muffle furnace, dissolved in nitrate acid solution, filtered 0.22 µL and read the absorbance on the AAS. All reagent dissolved in millipore water.

Glycaemic Index (GI)

Six male Balb/C mice were house individually in a light-controlled room (12/12 h dark/light), approved laboratory animal facility for 7-day adaptation period. The mice fasted for 8 h and given 0.5 mL of Talas Safira 37 g and 50 g carbohydrate equivalent. The Talas safira were ground with a mortar and pestle to pass a powder and then autoclaved. Glucose blood level were measured with a Accu-Check Glucose System. Glucose given at the same mice 7-day after treated with Talas safira.

Area under curve (AUC) was calculated geometrically using incremental method. The GI was calculated by expressing the glycaemic response area for the Talas safira as a percentage of the mean response area of glucose by same subjects.

Glycaemic Load (GL)

The GL was calculated as the GI (%) multiplied by the grams of carbohydrate in the serving of food eaten.

GL was calculated by the formula: (Net carbohydrates in a typical serving) x (GI) / (100)

RESULTS AND DISCUSSIONS

Proximate analysis of Talas safira

The proximate composition of Talas safira is shown in Table 1. The moisture content 69.36% and total ash content was recorded 1.70%. Sucrose, fructose, glucose and fibre totally as carbohydrate content 27.11%. Moisture is an important parameter in the storage, levels greater that

Table 2b: GI and GL index of Talas safira.

Sample	GI (%)		GL (%)	
	Value	Category	Value	Category
Talas Safira 37 g carbohydrate equivalent	112.052	High	41.04	High
Talas Safira 50 g carbohydrate equivalent	158.958	High	77.61	High

Note: GI categories: low ≤ 55; moderate 56-69 and high ≥70. GL categories: low ≤ 10; moderate > 10 x < 20 and high ≥ 20.

12% allow for microbial growth[11]. The main content of tuber is carbohydrate and could be main source of energy while the protein (except soybean) and fat were very limited[12,13]. Due to high carbohydrate content produced high calorie 380.55 kJ, too. Crude protein and fat content very low were 0.90% and 0.20%, respectively.

An oxalate diet needs to limit the ingest oxalates to 71 mg/100 g, high content oxalate food contains more than 10 mg associate to develop kidney stones[14]. Talas safira is rich source of macronutrient; calcium 39.10 mg/100 g, sodium 9.21 mg mg/100 g and zinc 0.15 mg mg/100 g. Calcium turns out to be the most important mineral with highest level. The order concentrations for rest of macronutrient analysed was Ca>Na>Zn (Table 2). Normally, macronutrients needed come from food. Macronutrients are essential for metabolic processes of body, and any deficiencies cause severe health problems[15,16].

Talas safira variety, field area, the soil and climate, agricultural process (adding of fertilizers and metal based-pesticides), harvesting tools, storage and commercialization conditions may be influenced to metal heavy contains in product[17,18]. Based on National Standardization Agency of Indonesia SNI 7387: 2009, below standard of Pb, Cd and as are 0.25, 0.2 and 0,25 mg/kg, respectively[19]. All heavy metals in Talas safira were below the standard limit of SNI.

The blood glucose response curve for Taro equivalent 37 g and 50 g carbohydrate compared with the response for glucose are shown in Fig 1. Different carbohydrate contents of the food may also explain the different curve; different curve will also give different AUC. The AUC was calculated using incremental method AUC_{min}. Ration AUC of sample compared to AUC of glucose definite as GI (Table 2).

The GI values of Talas safira were determined using a standard protocol using mice model. The GI value effected by type of starches and fibre contain, amylose high content has a significant lower GI and GL compared to normal amylose. Staple food with high GI or GL value correlated to beneficial health effect. The GI of food is the measurement of the effects of the carbohydrates in the food on blood glucose levels but the GL that increased insulin levels essentially make fat and increase the risk of developing diabetes. Thus parameter important since epidemiological studies have shown a positive association to the risk of type 2 diabetes[20].

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